

## CRUISE RESULTS

Japanese Charter Vessel Seiju Maru #28

Cruise No. SM 88-1

Aleutian Basin Walleye Pollock

Cooperative Japan/U.S. Echo Integration/Midwater Trawl Survey

July 31 - October 19, 1988

A cooperative Japan/U.S. survey of Aleutian basin pollock was conducted between July 31 and October 19, 1988. U.S. scientific personnel participated aboard the chartered Japanese fishing vessel Seiju Maru #28, a 51 m Hokotan stern trawler, as it carried out an acoustic/midwater trawl assessment of pelagic pollock in the Aleutian basin. The survey area included the region of the Aleutian basin east of the U.S./U.S.S.R. convention line between 52°30'N and 58°30'N. Initial testing of the acoustic system was conducted in Japanese waters. An intercalibration of the Japanese and U.S. echo integration systems was carried out in U.S. waters prior to starting survey operations.

## ITINERARY

Jul 31-Aug 15	Begin Leg I. Embark U.S. scientist. Depart Hachinohe, Japan. Perform preliminary evaluation of the acoustic system. Conduct acoustic intercalibration operations with the U.S. acoustic system near Makushin Bay.
Aug 16-17	End Leg I. Exchange U.S. scientists in Dutch Harbor.
Aug 18-Sep 2	Begin Leg II. Echo integration and midwater trawl (EIMWT) survey of the southeast portion of the Aleutian basin within U.S. territorial waters.
Sep 3-4	Standard target calibration in Makushin Bay.
Sep 5-11	End Leg II. Exchange U.S. scientists in Kodiak.
Sep 12-26	Begin Leg III. EIMWT survey of central Aleutian basin including international and U.S. territorial waters.
Sep 27-28	Standard target calibration in Makushin Bay.
Sep 29-30	End Leg III. Exchange U.S. scientists in Dutch Harbor.

- Oct 1-11            Begin Leg IV. Complete echo integration and **midwater** trawl survey of the central Aleutian basin in international and U.S. waters.
- Oct** 12-19        End Leg IV. Transit to Hachinohe. Disembark U.S. scientist.

### OBJECTIVES

The primary objectives of this cruise were to:

- 1) Collect echo integrator and **midwater** trawl data necessary to **determine** the distribution, biomass, and biological composition of walleye pollock in the Aleutian basin.
- 2) Collect pollock target strength data for use in scaling echo integrator outputs to estimates of absolute abundance.
- 3) Conduct an intercalibration between Japanese and U.S. acoustic assessment systems.
- 4) Collect dual beam measurements of a standard calibration sphere to provide real-time calibration of the acoustic system and detect changes in system performance with changes in transducer depth.

### VESSEL, ACOUSTIC EQUIPMENT AND TRAWL GEAR

Research was conducted aboard the Seiju Maru #28, a 51m Japanese commercial stern trawler chartered by the Fisheries Agency of Japan.

Acoustic data were collected using a Japanese computerized echo integration and target strength measurement system. The echo sounder's receiver consisted of two 20 log R time varied gain (TVG) channels for echo integration and two 40 log R (TVG) channels for dual beam target strength measurements. The entire system was installed in a portable container approximately 2m x 2m x **2.75m**. A **38kHz** dual beam transducer housed in a **1.3m** long **V-fin** was connected to the acoustic system by a **200m, 26.4mm** diameter double armored towing cable. The V-fin was towed at an average depth of **10m** at about 8 kts. The echo sounder transmitted at various repetition rates using a pulse length of about 0.6 milliseconds.

Biological samples were collected using a commercial **rope-wing midwater** trawl having a vertical opening of about 50m and a horizontal opening of about 30m. The cod end was fitted with a **3.2mm knotless** nylon mesh inner liner which was closed when the trawl was being used to sample small organisms. Information on

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1 Reference to trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service (NMFS), NOAA.

the horizontal and vertical net openings was collected using a **SCANMAR<sup>1</sup>** mensuration system. Water **temperature/depth** profiles were obtained at each trawl station using an expendable bathythermograph (XBT) .

#### SURVEY METHODS

Operations during Leg I involved preliminary testing of the acoustic equipment to observe and record overall system response. In addition, the **midwater** net was deployed to ensure it was fishing correctly before trawl sampling started. A cooperative study between the Seiju Maru #28 and the chartered U.S. fisheries research vessel Pelasos was conducted to compare the at-sea performance of each **nation's** acoustic system. The van containing the U.S. acoustic system used by the RACE division at the Northwest and Alaska Fisheries Center (NWAFC) was installed on the Pelasos.

During the first portion of the intercalibration study, the two vessels proceeded along parallel transects within 1/4 mile of each other while collecting echo integration data on the same mass of fish. The second portion of the study involved simultaneous echo integration by both acoustic systems while the vessels were moored together at anchor in protected waters. These sets of data will be compared after initial analyses have been completed.

Operations during Legs **II-IV** were conducted 24 hours a day and covered most of the Aleutian basin east of the **U.S./U.S.S.R.** convention line south of **58°30'N**. The survey design consisted of a series of parallel transects along a systematic trackline. Distances between transects were either 45 or 22.5 nm. Vessel speed while surveying was about 8 kt. Echo integration density estimates of adult pollock were calculated for 50 depth bins and summed over 1 or 2 minute time intervals to provide estimates of fish density per unit area.

**Midwater** trawl hauls were conducted periodically along the transect lines to determine species composition and biological characteristics of the echo sign. In addition, samples of adult pollock were collected from selected hauls and frozen for morphometric and meristic studies. Hauls with the net liner in place were also made when dense echo sign of smaller targets was indicated, generally within 35 meters of the surface. These hauls were made in an attempt to capture age 0 pollock and other small fishes.

Target strength data were collected several times during the survey when individual fish targets could be observed. Standard target calibrations were conducted at the end of Legs I, II, and III while at anchor in Makushin Bay, Unalaska Island. A solid copper sphere of known acoustic properties was suspended below the transducer while target strength data were collected. Data were obtained with the transducer at selected depths between 10 m and 70 m over a period of 8.5 hours.

## RESULTS

A total of 17 survey transects were completed, excluding cross transects. In addition, several exploratory transects were made at the end of Legs **II** and Leg **IV**. A total of 79 **midwater** hauls were completed, 37 without the net liner in place and targeted on adult pollock sign. Average net opening during these hauls was 35m wide by 44m high. The remaining 42 hauls were made with the **3.2mm** mesh liner secured in the **codend** and fished on smaller echo sign. Average net opening for these hauls was 23m wide and 45m high.

Figure 1 shows the transect pattern and haul locations for Legs **II**, **III**, and **IV**. At some positions, two hauls were conducted; one with the net liner secured in the **codend**, the other without the liner. At the remaining stations, only one of the haul configurations was used.

Pollock was the predominant species caught, accounting for 99.5% by weight and 99.3% by number in the catches of the 37 trawls made without the liner in place (Table 1). Trawl data and catch information for hauls made when the net liner was secured in the **codend** are presented in Table 2. A list of species collected by both net configurations is given in Table 3. A summary of the biological data collected is listed in Table 4. Any age 0 pollock which were found were preserved in **formalin** for later examination.

Catches of male pollock were generally higher than the catches of female pollock in the **midwater** hauls targeted on adult sign. Percent composition of males in these catches ranged from a low of 42% to a high of 72%, with the unweighted average being 58%.

The length ranges for adult pollock were 37cm-62cm for males and **41cm-61cm** for females (Fig 2). However, 98% of the males and 97% of the females were **44cm-54cm**. The average length of females (**50cm**) was higher than males (**48cm**). Of the 954 fish examined for maturity stage only one, a female, was found to be actively spawning.

There was no substantial feeding indicated from the approximately 220 pollock stomachs examined. When stomachs did contain food it consisted primarily of mysids and euphausiids. No evidence of cannibalism was found.

Figure 3 gives an approximate indication of density distribution of adult pollock. These densities were determined from catch rates only. The higher catches of pollock were observed in four different regions of the survey area. One was at the western edge of the international zone, a second at the most eastern portion of the international zone, another north of Atka Island, and the fourth near the shelf break south of the **Pribilof** Islands. All trawl hauls targeted on adult pollock were conducted at depths between **145m-210m**.

Of the 42 hauls conducted with the net liner secured in the **codend**, 36 were made within 45 m of the surface. The majority of

these catches consisted of small mesopelagic fish and age 0 pollock. Only small catches of age 0 pollock were obtained in any of these hauls. Figure 4 shows the distribution of the relative CPUEs of age 0 pollock from each of the 42 sampling locations.

#### JAPANESE SCIENTIFIC PERSONNEL

<b>Kazuyuki</b> Teshima	Fishery Biologist	FSFRL
Taku Yashimura	Fishery Biologist	FSFRL
Yoshimi Takao	Fishery Engineer	NRIFE
Kikuro Nemoto	Electronics Engineer	<b>Kaijo</b> Denki Co., Ltd.

#### U.S. SCIENTIFIC PERSONNEL

<b>Jimmie</b> Traynor	Fishery Biologist	NW AFC
John Garrison	Electronic Technician	NW AFC
Douglas Smith	Fishery Biologist	NW AFC
William Karp	Fishery Biologist	NW AFC

Table 1. Trawl haul stations and catch data, Cruise SM 88-1, net liner not secured.

Haul	Date (1988)	Start Pos.		Time of day (ADT)	Depth (fm) Gear/bottom	Temp (°C) Surface/ gear	Dura- tion (hr)	Dist. fished (nm)	Catch (lbs/nos.)	
		Lat(N)	Long(W)						Walleye Pollock	Other species
1	8/19	52°59'	172°45'	1200	101/1449	9.1/3.8	1.00	3.8	2524/1347	-
2	8/20	54°07'	171°50'	1000	80/1749	9.0/4.5	1.00	5.1	1270/616	4/1
3	8/20	55°09'	169°43'	2400	87/1553	9.1/4.8	.92	3.9	336/161	8/1
4	8/21	55°29'	170°36'	1200	98/1818	9.0/4.8	.50	1.9	2174/1051	-
5	8/21	55°22'	171°22'	1600	98/1818	13.8/4.5	.50	2.0	2675/1355	-
6	8/23	52°52'	176°16'	1600	101/1979	10.9/4.1	.50	2.4	533/270	-
7	8/24	53°05'	177°47'	1600	82/2009	8.8/4.0	1.00	3.6	422/218	-
8	8/24	53°42'	176°34'	2400	82/2009	9.1/4.4	1.00	3.0	161/87	-
9	8/25	54°52'	174°21'	1600	101/1750	10.9/4.1	1.00	2.4	1893/986	8/2
10	8/26	55°57'	172°07'	700	98/1759	9.2/3.7	1.00	4.3	1073/592	-
11	8/26	55°54'	171°11'	1600	98/688	8.9/4.8	.50	1.8	471/245	-
12	8/28	53°33'	175°57'	800	93/1999	9.2/3.4	1.00	3.7	285/141	-
13	8/28	52°52'	177°14'	1600	104/1979	9.2/3.4	1.00	3.8	182/90	-
14	8/29	52°29'	176°55'	300	76/1973	8.2/5.5	1.00	4.0	-	-
15	8/29	53°13'	174°38'	1600	104/2020	8.9/4.4	1.00	3.7	2911/1525	-
16	8/31	53°36'	170°23'	1900	115/1246	7.9/3.7	.73	4.0	912/457	5/1
17	9/01	54°03'	167°33'	1400	84/1022	7.8/5.5	1.00	4.4	814/392	-
18	9/02	53°54'	169°04'	700	84/111	8.3/4.6	1.60	6.7	2278/1104	-
19	9/15	54°24'	176°09'	1400	93/1981	8.5/3.5	1.00	3.7	506/292	6/2
20	9/16	54°08'	178°48'	2000	82/1687	8.1/4.9	1.50	7.1	661/328	1/1
21	9/17	55°34'	175°48'	1400	98/2001	8.6/4.1	1.50	5.9	3892/2114	10/2
22	9/18	56°12'	176°38'	1300	104/1969	8.8/3.4	.50	2.0	1334/721	12/6
23	9/20	55°26'	179°56'E	1300	104/2084	8.5/3.5	1.00	3.6	590/300	1/1
24	9/20	55°56'	179°06'	2300	93/2153	8.7/3.0	1.00	3.9	176/85	10/4
25	9/21	56°59'	177°03'	1200	98/2010	8.6/3.7	1.00	3.7	615/325	25/43
26	9/22	57°44'	177°34'	1600	109/1751	8.5/4.3	1.00	3.9	595/313	55/25
27	9/23	56°16'	179°37'E	1200	90/2106	8.2/3.5	1.50	5.8	1641/808	-
28	9/24	55°20'	176°19'E	1400	98/2188	8.7/3.2	1.50	5.8	657/315	1/1
29	9/25	56°56'	178°52'E	1000	85/2079	7.8/3.2	1.00	3.9	925/496	13/1

Table 1. (Cont.)

<u>Haul</u>	<u>Date</u> (1988)	<u>Start Pos.</u>		<u>Time</u> of day (ADT)	<u>Depth (fm)</u> Gear/bottom	<u>Temp ("C)</u> Surface/ gear	<u>Dura-</u> tion (hr)	<u>Dist.</u> fished (nm)	<u>Catch (lbs/nos.)</u>	
		<u>Lat(N)</u>	<u>Long(W)</u>						<u>Walleye</u> <u>Pollock</u>	<u>Other</u> <u>species</u>
30	10/03	57°05'	179°11'E	1600	101/2096	7.7/3.4	0.50	1.9	709/378	2/-
31	10/04	58°30'	179°19'	1600	115/1931	8.0/3.1	1.00	4.2	1084/564	7/-
32	10/05	56°49'	176°38'E	1600	109/2076	7.8/4.4	0.50	1.9	2670/1365	1/1
33	10/06	56°09'	173°59'E	1300	104/1704	8.5/4.3	0.50	1.7	3564/1847	-
34	10/06	56°40'	174°19'E	1900	104/2030	8.5/3.5	0.33	1.2	1448/758	9/7
35	10/07	58°27'	177°54'E	1500	90/2030	7.7/3.1	1.50	5.7	452/250	44/25
36	10/08	56°39'	175°47'E	1400	101/2062	9.0/8.4	1.00	3.6	1026/554	1/1
37	10/11	56°39'	174°49'E	1800	82/2062	8.2/4.0	0.25	0.9	3364/1852	3/2

Table 2. Trawl haul stations and catch data, Cruise SM 88-1, net liner secured.

Haul	Date (1988)	Start Pos.		Time of day (ADT)	Depth (fm) Gear/bottom	Temp ( C) Surface/ gear	Dura- tion (hr)	Dist. fished (nm)	Species observed in catch				
		Lat(N)	Long(W)						Mycto- phids	Euphau- sids	Pollock Age0 (No.)	Squid	Other species
101	8/20	54°02'	171°56'	800	22/1749	9.1/5.4	.62	1.9	-	X	-	-	X
102	8/21	54°47'	172°30'	2400	21/1929	9.2/5.4	.60	2.3	-	X	-	-	-
103	8/23	53°25'	175°13'	800	71/1999	9.3/4.7	.50	1.7	-	-	-	-	X
104	8/26	55°19'	172°25'	2400	19/1888	9.2/5.8	.50	1.9	X	-	-	-	X
105	8/27	54°40'	173°40'	800	19/1929	9.2/5.5	.50	1.9	-	X	-	-	X
106	8/29	53°15'	174°30'	1800	148/2005	8.8/4.2	.50	1.6	X	-	-	-	X
107	8/30	53°45'	173°27'	2400	16/1959	8.8/6.5	.50	1.9	X	-	8	X	X
108	8/31	53°07'	170°23'	2200	22/860	8.7/6.6	.85	2.8	X	X	25	X	-
109	9/02	53°46'	169°02'	1000	98/948	8.7/4.7	.50	2.1	-	-	-	-	-
110	9/02	53°45'	168°56'	1100	22/948	8.6/7.0	.50	2.2	-	-	75	-	-
111	9/16	53°50'	179°25'	1600	93/547	7.3/4.7	1.00	4.2	-	-	-	-	X
112	9/17	55°33'	175°53'	1300	16/2050	8.7/**	.50	1.9	-	-	4	X	X
113	9/17	55°53'	175°12'	1800	14/1901	8.4/9.4	1.50	5.3	-	-	5	X	X
114	9/17	56°27'	174°59'	2400	16/1901	8.7/5.2	1.00	4.2	X	-	-	X	-
115	9/18	56°09'	176°43'	1400	16/1969	8.7/8.8	1.00	4.1	X	-	36	X	-
116	9/19	54°45'	179°26'	900	19/2031	8.6/4.7	.60	2.2	-	-	-	-	-
117	9/19	54°26'	178°10'E	2400	19/1369	8.3/4.6	.50	2.2	X	-	-	-	-
118	9/20	55°29'	179°59'	1600	14/2084	8.6/5.1	1.00	3.8	X	-	-	X	-
119	9/20	56°01'	179°00'	2400	16/2079	8.6/7.6	.50	2.0	X	-	-	-	-
120	9/21	57°04'	177°00'	1400	16/1860	8.5/8.3	1.00	4.5	X	-	20	-	X
121	9/21	57°54'	175°09'	2400	16/1969	8.1/8.9	.50	1.9	X	-	3	X	X
122	9/22	57°41'	177°40'	1700	11/1751	8.4/4.9	1.00	4.2	-	-	4	X	X
123	9/22	57°20'	178°23'	2300	12/2024	8.1/5.0	.50	2.0	X	-	10	-	X

\*\* No temperature data recorded.

X Present

- Absent



Table 2. (Cont.)

Haul	Date (1988)	Start Pos.		Time of day (ADT)	Depth (fm) Gear/bottom	Temp (C) Surface/ gear	ma - tion (hr)	Dist. fished (nm)	Species observed in catch				
		Lat(N)	Long(W)						Mycto- phids	Euphau- sids	Pollock Age0 (No.)	Squid	Other species
124	9/22	57°16'	178°28'	2400	47/2024	8.1/3.7	.50	2.1	x	-	3	-	x
125	9/23	56°10'	179°33'E	1400	16/2106	8.7/6.7	1.00	4.3	-	-	4	x	x
126	9/23	55°37'	178°16'E	2300	15/1915	8.3/4.6	.60	2.4	x	-	3	-	-
127	9/24	55°25'	176°11'E	1600	12/2188	9.0/4.9	1.00	4.2	-	-	-	-	-
128	9/24	56°00'	177°01'	2300	10/2188	8.5/5.4	.50	2.2	x	-	-	-	x
129	9/25	56°59'	178°58'	1100	12/2024	7.8/4.3	1.00	4.4	-	-	-	x	x
130	9/26	55°12'	173°25'	1200	18/1915	8.2/5.9	1.00	3.8	-	-	-	-	x
131	9/26	54°49'	171°17'	2200	21/1870	8.1/5.3	.50	1.9	x	x	2	-	-
132	9/27	53°55'	167°36'	1100	12/850	7.8/8.3	1.00	4.3	x	-	40	-	x
133	10/03	57°33'	179°53'E	2400	10/2030	7.6/8.7	.50	1.9	x	-	-	-	x
134	10/04	58°30'	179°28'E	1700	10/1931	8.0/8.3	1.00	4.4	-	-	-	-	x
135	10/05	58°08'	179°14'E	2400	10/2010	8.1/8.6	.50	2.0	x	-	-	-	-
136	10/05	56°53'	176°45'E	1500	12/2076	7.9/8.6	1.00	4.0	-	-	-	x	x
137	10/05	56°09'	175°18'E	2400	10/2079	7.0/8.6	.50	2.2	-	-	-	x	x
138	10/06	56°12'	173°59'E	1400	15/1704	8.4/6.5	1.00	4.3	-	-	-	x	x
139	10/06	57°06'	175°10'E	2400	10/2024	8.4/7.4	.50	2.2	x	-	-	-	-
140	10/07	58°31'	178°03'E	1700	16/2030	7.4/7.9	1.00	3.4	x	-	-	x	-
141	10/07	57°44'	177°44'E	2400	15/2024	7.8/8.1	.50	1.8	-	-	-	x	x
142	10/08	56°36'	175°13'E	1600	30/2024	8.6/3.5	1.00	4.0	-	-	-	-	-

Table 3. Species captured during **SM881** cruise by each net configuration.

<u>Species</u>	<u>Without liner</u>	<u>With liner</u>
Walleye Pollock, Adult ( <u>Theragra chalcogramma</u> )	x	x
Walleye Pollock, Age 0 ( <u>Theragra chalcogramma</u> )		x
Smooth Lumpsucker ( <u>Aptocyclus ventricosus</u> )	x	
Lamprey (Unidentified)	x	
Lanternfish (Myctophidae)		x
<b>Snailfish</b> (Unidentified)		x
Chinook Salmon ( <u>Oncorhynchus tshawytscha</u> )		x
Sockeye Salmon ( <u>Oncorhynchus nerka</u> )		x
Eulachon ( <u>Thaleichthys pacificus</u> )		x
Fish larvae (Unidentified)		x
Squid (Unidentified)	x	x
Euphausiid (Unidentified)		x
Shrimp (Unidentified)		x
Jellyfish (Unidentified)		x
<b>Copepod</b> (Unidentified)		x
<b>Amphipod</b> (Unidentified)		x
Plankton (Unidentified)		x

Table 4. Summary of biological data collected on pollock during SM881.

Haul No.	Lengths	Matur.	Otoliths	Stomach Scans	Preserved Samples		
					Adult Pollock (U.S.)	Adult Pollock (Japan)	Juvenile Pollock (Japan)
1	142	30	30	-	40		
2	211	25	25	-	-		
3	161	-	-	-	-		
4	233	29	29	10	-		
5	268	30	30	-	-		
6	226	30	30	10	-		
7	178	30	30	-	40		
8	87	-	-	-	-		
9	288	30	30	9	-		
10	317	30	30	10	40		
11	299	30	30	-	-		
12	124	30	30	-	-		
13	90	-	-	-	-		
14	-	-	-	-	-		
15	275	30	30	-	40		
16	280	30	30	-	-		
17	294	30	30	-	-		
18	265	30	30	-	-		
19	292	30	30	-	-		
20	328	30	30	4	-		
21	421	30	30	7	50		
22	529	30	30	6	-		
23	245	30	30	7	-		
24	89	-	-	-	-		
25	256	30	30	-	-		
26	245	30	30	6	-		
27	497	30	30	-	50		
28	300	30	30	-	30		
29	464	30	30	-	-		
30	378	30	30	-	-		
31	503	30	30	-	-		
32	999	30	30	30	-		
33	999	30	30	30	-		
34	575	30	30	30	-		
35	250	30	30	30	-		
36	554	30	30	30	-		
Σ	513	30	30	-	-		
Total	11257	954	954	219	290		

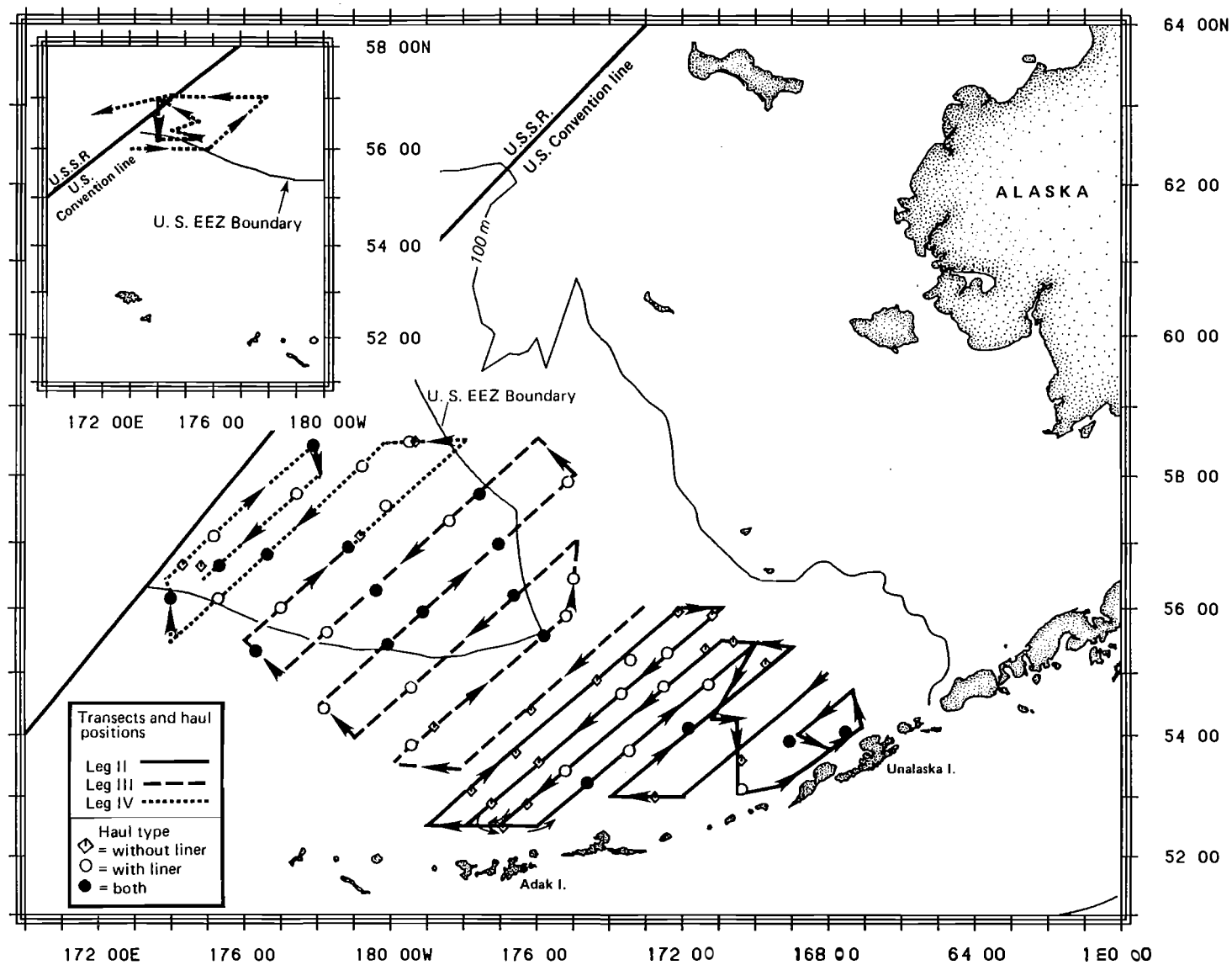
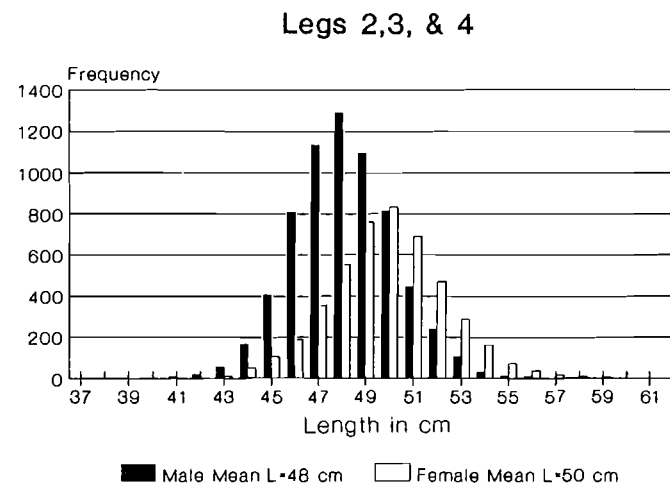
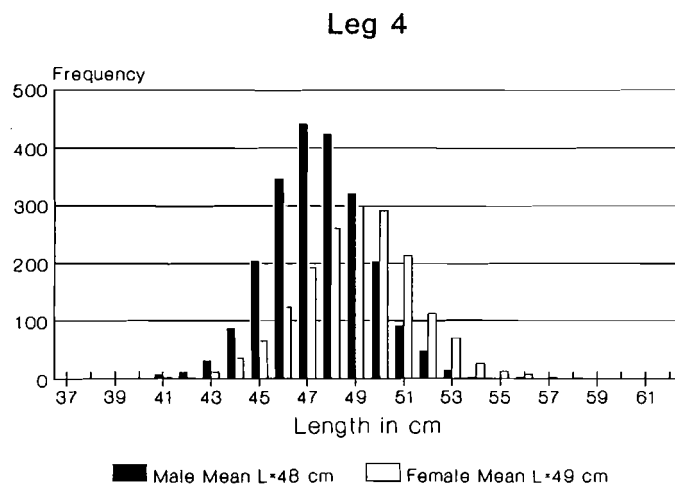
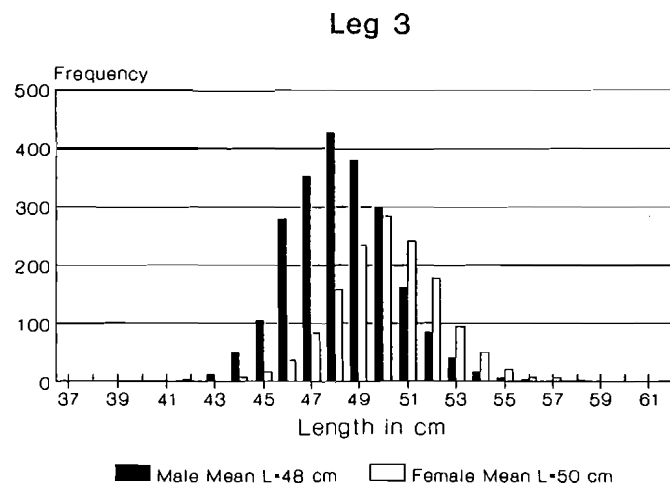
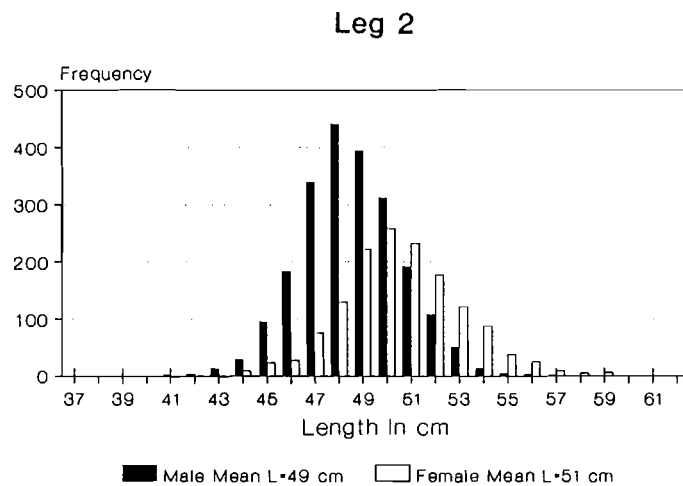


Figure 1. Survey trackline and haul positions for cruise EM-1. Insert shows exploratory transects conducted at the northern end of Leg IV.



**Figure 2.** Unweighted length frequency distribution by sex for each leg and all legs combined, cruise SM 88-1.

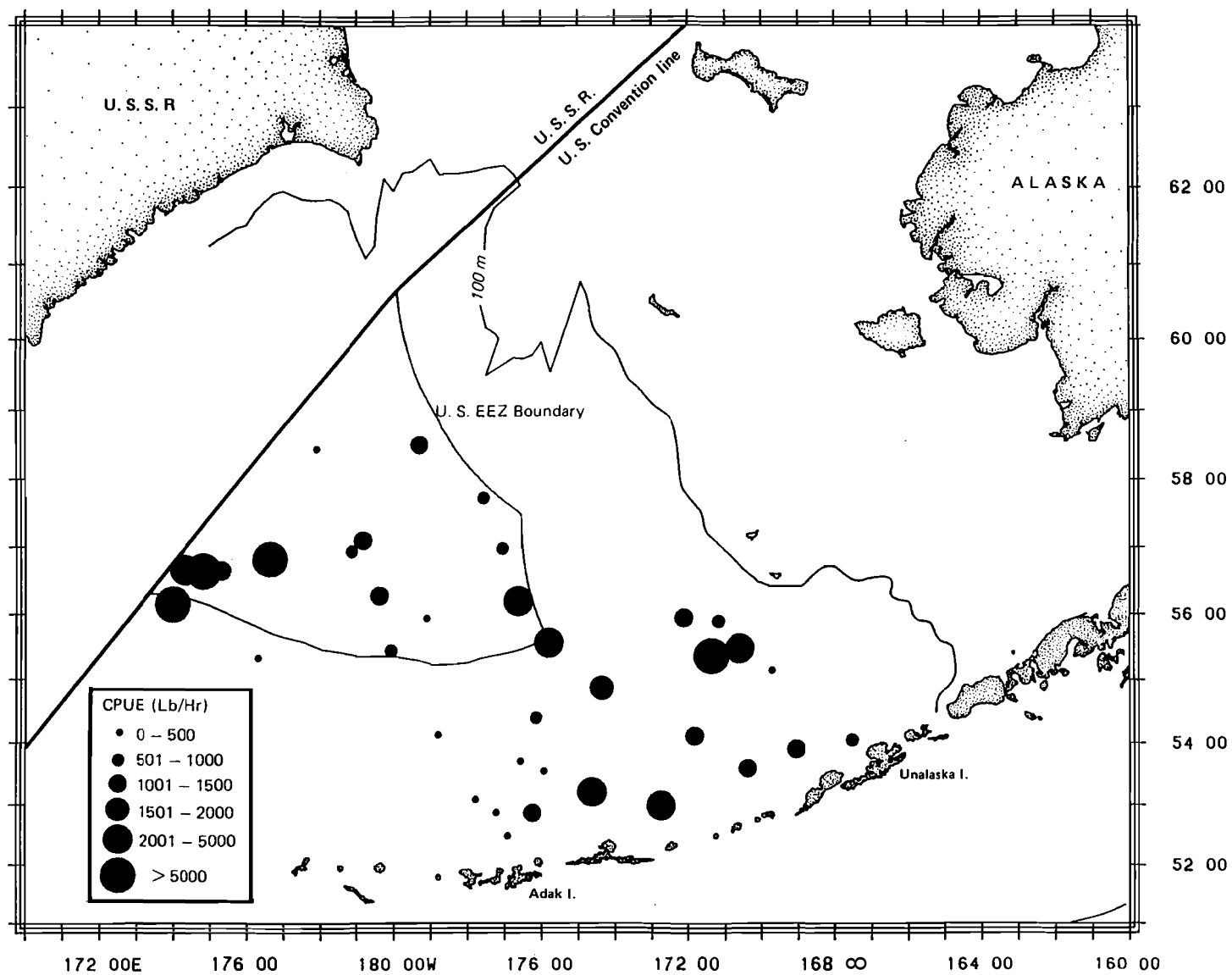


Figure 3 Distribution of CPUE of adult walleye pollock in midwater trawls cruise SM 88-1.

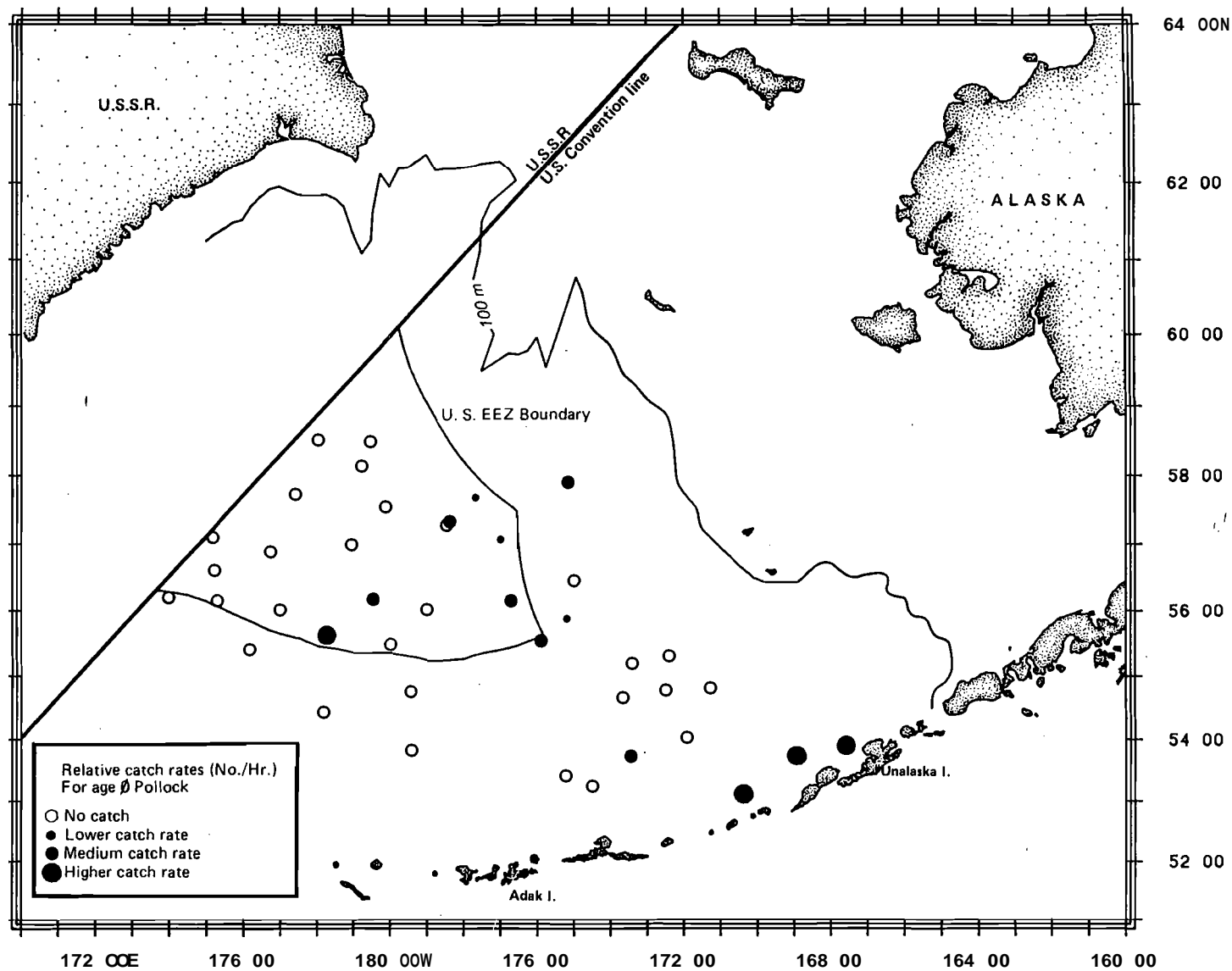


Figure 4. Distribution of relative catch rates of age 0 pollock in hauls where net liner was used in codend, cruise SM 88-1.